

REMARKS

The above amendments and the following remarks are fully and completely responsive to the Office Action dated June 2, 2005. Claims 1-3, 6 and 7 are pending in this application with claims 4-5 withdrawn from consideration. By this Amendment, claims 1-3, 6 and 7 have been amended. In the outstanding Office Action, the title was objected to and claims 1-3, 6 and 7 were rejected under 35 U.S.C. § 103(a) (three different rejections). No new matter has been added. Claims 1-3, 6 and 7 are presented for reconsideration.

Title Objection

The Office Action objected to the title as not being descriptive. Applicant has amended the title such that the new title is clearly indicative of the invention to which the claims are directed. Accordingly, Applicant respectfully requests reconsideration and withdrawal of the objection to the title.

35 U.S.C. § 103(a)

Claims 1-3 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hosier (U.S. Patent No. 6,157,019) in view of Perry et al. (U.S. Patent No. 6,548,323, "Perry"). In making this rejection, the Office Action asserts that the combination of these two references teaches and/or suggests the claimed invention. The Office Action also asserts that one of ordinary skill in the art would combine these two references. Applicant disagrees and respectfully requests reconsideration of this rejection.

Claim 1, as amended, recites in part:

...wherein the metal conductor layer is formed around the openings individually so as to prevent light from striking the photoelectric conversion elements except through the openings, and

wherein a metal conductor having substantially a same width as the metal conductor layer is formed integrally with the metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to an edge of the IC chip.

Claim 2, as amended, recites in part:

...a first metal conductor layer formed around the openings individually so as to prevent light from striking the photoelectric conversion elements except through the openings; and

a second metal conductor layer having substantially a same width as the first metal conductor layer and formed between an edge of the IC chip and the first metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to the edge of the IC chip so as to shut off light coming obliquely from above in a direction of the edge of the IC chip.

In Figs. 7 and 8, Hosier discloses a plurality of photoelectric conversion elements 12 that are formed in rows on an IC chip 10. On three sides of the photoelectric conversion elements 12, located next to V-groove 18, a conductor layer 50 limits the light striking the photoelectric conversion element 12. On the fourth side of the photoelectric conversion elements 12, which appears to coincide with the edge of the chip, an opaque layer 100 is formed on the V-groove 18 and between adjacent photoelectric conversion elements 12 that are in the same column.

The Office Action admits that Hosier fails to disclose that the opaque layer is a metal conductor layer having substantially a same width as the conductor layer. The Office Action cites Perry as correcting this deficiency in Hosier.

Perry teaches spray coating the lateral edges of a semiconductor substrate with an opaque layer to prevent light from entering the semiconductor substrate to the lateral edges and interfering with the operation of the light-sensitive IC. Perry also discloses that the opaque material may be a metal that is commonly used for other purposes in the semiconductor industry, such as aluminum, titanium, titanium nitride, cobalt, tungsten, or combinations thereof. Perry, however, fails to teach and/or suggest any particular width of the conductor layer. Consequently, Perry fails to teach and/or suggest that the metal conductor layer has substantially the same width as the conductor layer.

Furthermore, Applicant notes that an object of Hosier is to reduce the dead space and make the size of the photosites 12 larger by making the metal light shield layer 50 that surrounds the photosites 12 as small as possible or removing the metal light shield layer at certain locations. Hosier also discloses removing a guardring diffusion layer 40 so that the size of the photosites 12 may be further increased. The increase in size of photosites 12 reduces the undesirable effects of Moiré. The opaque filter layer 100 replaces the metal light shield layer 50 and the guardring diffusion layer 40 at the edge of the chip. Hosier also suggests that the opaque filter layer 100 preferably overlaps V-grooves 18 by 2-4 micrometers. To achieve the object of Hosier's invention, as shown in Figs. 7 and 8, photosites 12 are located at the edge of the chip (e.g., left edge) so that the photosites 12 can be made as large as possible. As shown

in Figs. 7 and 8, photosites 12 are defined from the very edge of the IC chip 10 and collect light from the upper direction. Light from the lateral edges is shielded by the opaque filter layer 100 which overlaps the V-grooves 18.

Accordingly, the combination of Hosier and Perry fails to teach and/or disclose the claimed invention. Regarding claim 1, the combination of these two references fails to teach and/or suggest that the metal conductor layer is formed around the openings individually so as to prevent light from striking the photoelectric conversion elements except through the openings. The combination of these two references also fails to teach and/or suggest that a metal conductor having substantially the same width as the metal conductor layer is formed integrally with the metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to an edge of the IC chip. Regarding claim 2, the combination of these two references fails to teach and/or suggest a first metal conductor layer formed around the openings individually so as to prevent light from striking the photoelectric conversion elements except through the openings. The combination of these two references also fails to teach and/or suggest a second metal conductor layer having substantially a same width as the first metal conductor layer and formed between an edge of the IC chip and the first metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to the edge of the IC chip so as to shut off light coming obliquely from above in a direction of the edge of the chip. Claim 3 depends from claim 2. Accordingly Applicant respectfully requests reconsideration and withdrawal of the rejection of claims 1-3 under 35 U.S.C. § 103(a).

Claim 6 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Hosier in view of Lee et al. (U.S. Patent No. 5,349,216, "Lee"). In making this rejection, the Office Action asserts that the combination of these two references teaches and/or suggests the claimed invention. The Office Action also asserts that one of ordinary skill in the art would combine these two references. Applicant respectfully disagrees and requests reconsideration of this rejection.

Claim 6, as amended, recites in part:

...a first metal conductor layer formed on a surface of the insulating layer with openings formed above the photoelectric conversion elements and in such a way as to surround the openings, the first metal conductor layer serving to prevent light from striking the photoelectric conversion elements except through the openings;

a second metal conductor layer having substantially a same width as the first metal conductor layer and formed between an edge of the IC chip and the first metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to the edge of the IC chip so as to shut off light coming obliquely from above in a direction of the edge of the IC chip; and

a plurality of contact holes formed at predetermined intervals in at least one row in the insulating layer so as to surround each of the openings individually along every side thereof, the contact holes serving to connect the first metal conductor layer to the semiconductor substrate and simultaneously preventing light from striking the photoelectric conversion elements through openings other than the openings formed right above the respective photoelectric conversion elements.

As discussed above, Hosier fails to teach and/or suggest a first metal conductor layer formed on a surface of the insulating layer with openings formed above the photoelectric conversion elements and in such a way as to surround the openings, the first metal conductor layer serving to prevent light from striking the photoelectric

conversion elements except through the openings. As also discussed above, Hosier fails to teach and/or suggest a second metal conductor layer having substantially the same width as the first metal conductor layer and formed between an edge of the IC chip in the first metal conductor layer in an area extending from a photoelectric conversion element located at an end of the row to the edge of the IC chip so as to shut off light coming obliquely from above in a direction of the edge of the IC chip.

The Office Action admits that Hosier fails to disclose an insulating layer formed over an entire surface of the IC chip and around the photoelectric conversion elements and a plurality of contact holes formed at predetermined intervals in the insulating layer so as to surround the openings, the contact holes serving to connect the metal conductor layer to the semiconductor substrate and preventing light from striking the photoelectric conversion elements through openings other than the openings formed right above the respective photoelectric conversion elements. The Office Action cites Lee as correcting this deficiency in Hosier.

Lee discloses, in Figure 3, an image sensor including a semiconductor substrate 30. An insulation layer 37 is formed over an entire surface of the sensor. The insulation layer 37 has a plurality of contact holes 37a which are filled with conductor films 37b. The contact holes 37a are shown at two locations per element in cross-section view. Consequently, the contact holes 37a of Lee cannot be the contact holes recited in claim 6. Specifically, contact holes 37a of Lee cannot be the contact holes formed at predetermined intervals in at least one row in the insulating layer so as to surround each of the openings individually along every side thereof. Consequently, Lee fails to teach and/or suggest this element of claim 6.

Therefore, the combination of Lee and Hosier fails to teach and/or suggest the claimed invention. Specifically, the combination of these two references fails to teach and/or suggest a first metal conductor layer formed on a surface of the insulating layer with openings formed above the photoelectric conversion elements and in such a way as to surround the openings, the first metal conductor layer serving to prevent light from striking the photoelectric conversion elements except through the openings. The combination of these two references also fails to teach and/or suggest a second metal conductor layer having substantially the same width as the first metal conductor layer and formed between an edge of the IC chip and the first metal conductor layer in an area extending from a photoelectric conversion element located at one end of the row to the edge of the IC chip so as to shut off light coming obliquely from above in a direction of the edge of the IC chip. The combination of these two references also fails to teach and/or suggest a plurality of contact holes formed at predetermined intervals in at least one row in the insulating layer so as to surround each of the openings individually along every side thereof. Therefore, Applicant respectfully requests reconsideration and withdrawal of the rejection of claim 6 under 35 U.S.C. § 103(a).

Claim 7 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Hosier in view of Perry and further in view of Lee. In making this rejection, the Office Action asserts that the combination of these three references teaches and/or suggests the claimed invention. The Office Action also asserts that it would be obvious to one of ordinary skill in the art to combine these three references. Applicant respectfully disagrees and requests reconsideration of this rejection.

Claim 7, as amended, recites in part:

...a plurality of contact holes formed at predetermined intervals in at least one row in the insulating layer so as to surround each of the openings individually along every side thereof...

Claim 7 depends from claim 2 and is distinguished from the combination of Hosier and Perry as discussed above.

The Office Action admits that the combination of Hosier and Perry fails to teach and/or suggest the plurality of contact holes recited in claim 7. The Office Action cites Lee for correcting this deficiency in the combination of Hosier and Perry.

However, as discussed above regarding claim 6, Lee fails to teach and/or suggest a plurality of contact holes formed at predetermined intervals in at least one row in the insulating layer so as to surround each of the openings individually along every side thereof. Consequently, the combination of Hosier, Perry and Lee fails to teach and/or suggest the invention recited in claim 7. Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejection of claim 7 under 35 U.S.C. § 103(a).

Conclusion

Applicant's amendments and remarks have overcome the objection and rejections set forth in the Office Action dated June 2, 2005. Specifically, Applicant's amendment of the title has overcome the objection to the title. Applicant's remarks have distinguished claims 1-3 from the combination of Hosier and Perry and thus overcome the rejection of these claims under 35 U.S.C. § 103(a). Applicant's remarks have distinguished claim 6 from the combination of Hosier and Lee and thus overcome

the rejection of this claim under 35 U.S.C. § 103(a). Applicant's remarks regarding claim 7 have distinguished this claim from the combination of Hosier, Perry and Lee and thus overcome the rejection of this claim under 35 U.S.C. § 103(a). Claims 4 and 5 have been withdrawn. Accordingly, claims 1-3, 6 and 7 are in condition for allowance. Therefore, Applicant respectfully requests consideration and allowance of claims 1-3, 6 and 7.

Applicant submits that the application is now in condition for allowance. If the Examiner believes the application is not in condition for allowance, Applicant respectfully requests that the Examiner contact the undersigned attorney by telephone if it is believed that such contact will expedite the prosecution of the application.

In the event that this paper is not considered to be timely filed, Applicant respectfully petitions for an appropriate extension of time.

The Commissioner is authorized to charge payment for any additional fees which may be required with respect to this paper to our Deposit Account No. 01-2300, making reference to attorney docket number 103213-00041.

Respectfully submitted,
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